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ORIGINAL STUDY

Early complications after revision total hip arthroplasty with cemented dual-mobility socket and reinforcement ring

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Encouraged by the success of dual-mobility sockets in achieving implant stability in primary hip replacement, surgeons have started to use the implant in revision hip arthroplasty. However, very little is known yet about the postoperative complication rate of this type of implant when fixation in a reinforcement ring is required. In our department, 37 dual-mobility sockets were cemented in a reinforcement ring for revision hip arthroplasty in 36 patients over a period of two years. The mean follow-up period was 16 months (range, 6-27 months). Indications for revision hip arthroplasty included, among others, recurrent dislocation (3 cases) and implant loosening (9 cases) with extensive bone loss. We observed two single re-dislocations (5.40%), one infection and one mechanical failure of the reinforcement ring ; the literature mentions dislocation rates of 2.7 to 10.6% after revisions not specifically for recurrent dislocation. Revision hip arthoplasty combining dual-mobility sockets with reinforcement ring fixation thus had a relatively low early postoperative complication rate in this challenging group of patients. The design therefore seems to be a valid alternative to constrained implants, especially in high-risk revision cases. Despite the short follow-up period, cemented dual-mobility sockets seem to be a valuable option when reinforcement rings need to be used, with an acceptable dislocation rate in this challenging group of patients. But long-term survival studies are mandatory to evaluate stability and fixation longevity.

Keywords : revision hip arthroplasty ; dual-mobility socket ; reinforcement ring ; complications.

INTRODUCTION

Revision hip arthroplasty is known to be a very challenging procedure, especially in the presence of severe wear-induced osteolysis, frequently resulting in extensive bone defects at either the acetabular side, the femoral side, or both (*4,10*). Soft-tissue defects may further jeopardise the stability of the hip, resulting in dislocation rates as high as 50% after revision surgery. In those cases, re-revision is often required (*19*). Many treatment options have been described to address this problem ; they include conservative (closed reduction, patient education and long-term bracing) as well as surgical strategies (modification of the components, elimination of impingement, correction of soft-tissue deficiency, capsulorrhaphy and even resection arthroplasty).

Extensive bone defects at the acetabular side often necessitate the use of bone grafts and a reinforcement ring, which is fixed to the remaining bone with multiple screws (*13*). In those cases, a

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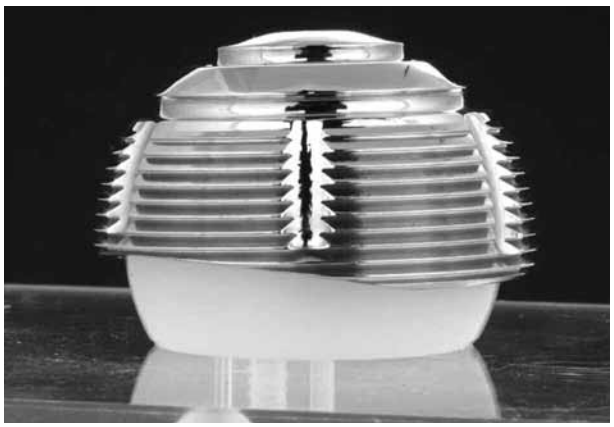

Fig. 1. — Apogee dual-mobility system, cemented version

small-diameter (28-36 mm) cemented (highly cross-linked) polyethylene liner can be used as final bearing. Other options include a fully constrained device or a dual-mobility socket, as both can be cemented in a reinforcement ring (*15*).

The dual-mobility socket (Fig. 1) was developed in France by Bousquet (*3,22*) and was found to provide excellent results for primary indications. Specifically, stability of the implant has been reported to be exceptional, both early postoperatively and at long-term follow-up : Vielpeau *et al* (*22*) reported only 1.14% dislocations in a first series of 437 primary arthroplasties after a mean follow-up period of 16.5 years, and 0% in a second series of 231 primary arthroplasties after a mean follow-up period of 5 years. Also Philippot *et al* (*17*) reported a 0% dislocation rate after primary arthroplasty with the dual-mobility socket, even in cases where constrained components are generally recommended.

Encouraged by these promising results, surgeons have successfully adopted the system in revision arthroplasty (*7*). However, very limited information is available on the combined use of a cemented dual-mobility socket and a reinforcement ring in the challenging setting of acetabular bone deficiency.

The purpose of this paper was therefore to describe the early results and the early complications with the use of a dual-mobility socket cemented in a reinforcement ring as a possible alternative to cemented small-diameter bearings for similar indications.

Table I. — Indications for revision

Cause of revision	Number	%
Loosening	9	24.3
Osteolysis	11	29.7
Periprosthetic fracture	3	8.1
Infection	10	27
Recurrent dislocation	3	8.1
Other	1	2.7

MATERIALS AND METHODS

Over a period of two years, between September 2008 and December 2010, 37 dual-mobility sockets were cemented in a reinforcement ring for revision hip arthroplasty in 36 patients. The group consisted of 16 male and 20 female patients (17 left and 20 right hips). The mean patient age at the time of surgery was 70.43 years (range : 46 to 93, median 73). The mean follow-up period was 16 months (range : 6-27 months). No patients were lost to follow-up ; one patient died of a cause not related to the procedure. The indications for revision are listed in Table I. The mean preoperative Harris hip score (HHS) and Merle d'Aubigné score (MDA) were 39.95 (range : 6-84, median 42) and 8.05 (range : 3-16, median 8), respectively.

In 27 cases, both the acetabular and femoral components were revised, while in 10 cases only revision of the acetabular component was performed. The acetabular bone defect after removal of the acetabular component was classified as Paprosky 2C or higher in all cases, and therefore necessitated the use of a reinforcement ring (*14*). All surgery was done by the same senior surgeon through a posterolateral approach.

In all cases, the cemented version of the Apogee dual-mobility socket (Biotechni Inc., Marseille, France) was used. This system consists of a 28-mm head which is constrained in a large-diameter conventional polyethylene head moving freely within either a cemented or a cementless metal shell with a 10 degrees elevated rim (Fig. 1). In all cases, the socket was cemented using Palacos® (Heraeus Inc., Hanau, Germany). The mean diameter of the cemented dual-mobility socket was 50 mm (range : 48-58 mm).

A total of 37 reconstruction rings, either a Ganz ring (n = 35) (Zimmer Inc., Warsaw, IN, USA) or a Burch Schneider ring (n = 2) (Zimmer Inc., Warsaw, IN, USA) was used as back up for the new liner (Fig. 2). They were inserted into the acetabulum in a non-cemented fashion

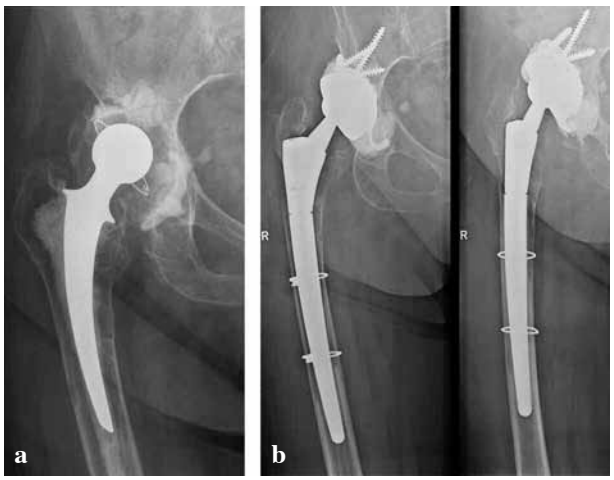

Fig. 2. — (a) Radiograph of an 86-year-old female patient preoperatively, and (b) after revision with Ganz reinforcement ring and Apogee dual-mobility socket in combination with a modular stem.

with multiple screws, after which the dual socket was cemented into the reconstruction ring.

If both components had to be revised, a modular stem (Profemur®-R, Wright Medical Inc., Arlington, TN, USA) was used on the femoral side to adapt the femoral version to the acetabular version, so as to obtain an optimal range of motion and to avoid impingement (*16*).

The average operating time was 1.5 hour (range : 1-3 hours). Postoperatively all patients received prophylactic antibiotics (cefazoline 3 × 2 g) for 24 hours, and indomethacin 3 × 25 mg daily for 3 weeks to reduce the risk of periarticular ossifications. The antithrombotic prophylaxis consisted of low-molecular-weight heparin and compression stockings for 6 weeks after the surgical procedure.

Postoperative rehabilitation was started within one week. All patients were evaluated clinically and radiographically at regular intervals, i.e. at 6 weeks, 3 months, 6 months, 1 year, and then every year.

RESULTS

Four complications were encountered (Table II). Remarkably, the 2 dislocations (5.4%) occurred within 2 weeks in patients who had been revised for recurrent dislocation ; their abductor mechanism was partially destroyed or completely absent. They were treated conservatively with closed reduction and bracing for 6 weeks, without recurrence. No intra-prosthetic dislocation of the dual-mobility system has been observed so far. A single complication not related to the dual-mobility socket itself was mechanical failure of the reconstruction ring, which occurred 6 months postoperatively (Fig. 3). One patient developed an infection with consequent massive sepsis eventually necessitating disarticulation of the hip joint.

Table II. — Complications with dual-mobility sockets

Initial cause for revision	Number	Complication
Recurrent dislocation	2	Single dislocation
Clinical failure	1	Infection necessitating disarticulation
Infection	1	Mechanical failure of reinforcement ring

DISCUSSION

Stability after revision THR : a problem

In our department, 300 hip replacements are performed annually, including 60 total hip revisions. In the majority of these revision cases, a cementless socket can again be used in combination with a modular uncemented stem. The biggest challenge remains stability of the hip, especially when no posterior capsular tissue is available, as all procedures are performed using the posterolateral approach (*8*). The problem becomes even more apparent in the presence of large bone defects or when the abductor mechanism is absent. In the event of poor bone stock, a reinforcement ring, usually combined with bone allografts, can be used on the acetabular side. As positioning and orientation of the ring are mostly dictated by the bony remnants of the acetabulum, care should be taken to avoid malpositioning of the cemented liner, as this could result in impingement or insufficient version of the components leading to instability of the hip. This problem can be solved partially by using larger femoral heads (*1,2,5,9,20*). According to Regis *et al* (*18*) stem modularity alone is not effective in reducing the dislocation rate in hip surgery. Hip surgeons may sometimes be tempted to use constrained acetabular cups when confronted with a severe stability problem in total

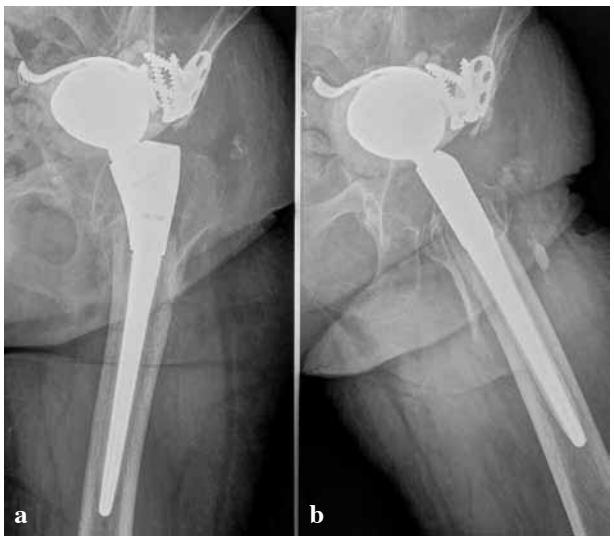

Fig. 3. — Mechanical failure of a Ganz reinforcement ring 6 months postoperatively in a 51-year-old female.

hip arthroplasty. However, constrained cups are not without complications, more specifically potential impingement, as reported by Pattyn *et al* (6) and Fricka *et al* (15). In addition, long-term fixation failure of these designs has been reported to be a major drawback (*23*).

The dual mobility socket in revision arthroplasty

Leiber-Wackenheim *et al* (*7*) reported a re-dislocation rate of only 1.7% after 59 revisions for recurrent dislocation, using the dual mobility socket, with a mean follow-up period of 8 years. These results were better than those obtained in most series of revision by constrained cup for recurrent dislocation. Hamadouche *et al* (*11*) noted 4.25% of re-dislocations in 47 patients with recurrent dislocation after a mean follow-up period of 51.4 months, also with the dual mobility socket.

These data plead for the use of the dual mobility socket, also when recurrent dislocation is not the major problem, as in the current study. However, when a reinforcement ring needs to be added, it seems advisable to cement a large-diameter dual mobility socket into the ring, although pertinent literature is still lacking. The current study focused on this double problem. In spite of that double problem the dislocation rate of 5.40% in 37 hips after a mean follow-up of 16 months compared favourably with the results of, for instance, Hummel *et al* (*8*), after revision arthroplasty, also not specifically for recurrent dislocation : 2.7% of dislocations, using large femoral heads and capsule repair, and 10.6% using small femoral heads without capsule repair.

Intraprosthetic dislocation

This is the main limitation of this method (*17*). Lyons *et al* (*12*) reported a 3.6% incidence of intraprosthetic dislocation of the dual-mobility socket, probably caused by polyethylene wear of the smaller articulation of the dual system. No intra-prosthetic dislocations have been encountered in our group so far. Somehow, concerns exist about polyethylene wear with the use of large-diameter polyethylene dual-mobility sockets. However, although the long-term durability of these implants is unknown, the tested wear rates of a dual-mobility design with the current generation of highly cross-linked polyethylene are significantly lower than any previously reported wear rates (*21*).

Impingement between femur and reconstruction ring

This complication was not observed, but care should be taken intraoperatively to avoid this potential problem.

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